1. In the excel file you will find the Degree of Reading Power (DRP) scores for a sample of 44 third-grade students. These students can be considered to be a SRS of the third-graders in a suburban school district. DRP scores are approximately normal. Replace standard deviation of scores in this school district with sample standard deviation. The researcher believes that the mean score $\mu$ of all third-graders in this district is higher than the national mean, which is 32.

   (a) State the appropriate $H_0$ and $H_a$ to test this suspicion;

   (b) carry out the test and calculate $p$-value;

   (c) interpret the result in plain language. (Choose a proper rejection region by yourself.)

2. Tooth decay generally develops first on teeth that have irregular shapes (typically molars). The most susceptible surfaces on these teeth are the chewing surfaces. Usually the enamel on these surfaces contains tiny pockets that tend to hold food particles. Bacteria begin to eat the food particles, creating an environment in which the tooth surface decays.

   Of particular importance in the decay rate of teeth, in addition to the natural hardness of the teeth, is the form of food eaten by the individual. Some forms of carbohydrates are particularly detrimental to dental health. Many studies have been conducted to verify these findings, and we can imagine how the study might have been run. A random sample of 60 adults was obtained from a given locale. Each person was examined and then maintained a diet supplement with a sugar solution at all meals. At the end of a one-year period, the average number of newly decayed teeth for the group was 0.70, and the standard deviation was 0.4. Do these data present sufficient evidence to indicate that the mean number of newly decayed teeth for people whose diet includes a sugar solution is greater than 0.30, a rate that had been shown to apply to persons whose diet did not contain the sugar solution supplement? Use $\alpha = 0.05$.

3. You want to see if a redesign of a mail-order catalog will increase sales. A very large number of customers will receive the original catalog, and a random sample of customers will receive the one with the new cover. For planning purposes, you are willing to assume that the sales from the new catalog will be approximately normal with $\sigma = 60$ dollars and that the mean for the original catalog will be $\mu = 40$ dollars. You decide to use a sample size of $n = 1000$. You wish to test

   $$H_0 : \mu = 40 \qquad H_a : \mu > 40$$

   You decide to reject $H_0$ if $\bar{X} > 43.12$ and to accept $H_0$ if otherwise.

   (a) Find the probability of a type I error, that is, the probability that your test rejects when in fact $\mu = 40$ dollars (*Hint: By definition of type I error, calculate* $P(\bar{X} > 43.12) \mid \mu = 40)$)

   (b) Find the probability of type II error when the actual $\mu = 45$ dollars. This is the proability that your test accepts $H_0$ when in fact $\mu = 45$ (*Hint: By definition of type II error, calculate* $P(\bar{X} < 43.12 \mid \mu = 45)$ )

   (c) Calculate the power of the test when $H_a : \mu = 50$.

   (d) The distribution of sales is not normal, because many customers buy nothing. Why is it nonetheless reasonable in this circumstance to assume that the mean will be approximately normal?

4. Can a 6-month exercise program increase the total body bone mineral content (TBBMC) of young women? A team of researchers is planning a study to examine this question. Based on the results of a previous study, they are willing to assume that $sigma = 2$ for the percentage change in TBBMC over the 6-month period. 1 percentage change in TBBMC would be considered important, and the researchers would like to have a reasonable chance of detecting a change this large or larger. How does the power of the test of an simple random sample (SRS) of size 25 change if type I error is increased from 5% to 10%.